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ABSTRACT

Extensive research on the impact of high school vocational education on post-school earnings has produced mixed results. Some studies find wage gains only for individuals who work in an occupation that is directly related to the vocational training received in high school. We shed light on this debate by focusing on a single occupation and by comparing the careers of individuals with and without occupation-related training in high school. We use a rich longitudinal data set that captures the careers of cohorts of military recruits who complete high school military science classes via the JROTC program. JROTC shares characteristics with both vocational training and school-to-career programs. We find that the occupation-specific training received via JROTC reduces short run turnover and improves longer run job stability for those who choose military jobs, suggesting that one important effect of vocational training is to improve the quality of the job match. We also find that vocational trainees promote at higher rates after four years in the job; however, this is due to the head start provided by the vocational education background rather than their faster advancement in the hierarchy.

Keywords: vocational education; military training; turnover; promotion; internal labor markets.

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I. Introduction

The role of vocational education in the high school curriculum has been a controversial area in education reform debates in the U.S. (Bishop, 1989; Levesque, et al., 2000). The controversy has been fueled in part by the inconsistent results in prior studies on the impact of vocational education on graduates' labor market success. Several studies find positive earnings effects of vocational education while others find no differences (for a survey see Bishop and Mane, 2004). One reason for the inconsistent results is that positive wage gains may accrue only when vocational graduates work in occupations that are directly related to their vocational training (Neumann and Ziderman, 1991; 1993). This finding raises questions about the effectiveness of vocational education since only 43% of vocational graduates work in occupations that match their training (Bishop, 1989). Hotchkiss (1993), on the other hand, finds that wage gains are most likely due to the choice of occupation rather than to vocational education or to working in a training-related occupation. Further complicating the picture, Meer (2007) finds that high school students sort themselves into tracks (vocational, academic) based on comparative advantage, and this self-selection accounts for the wage gains to vocational students. This controversy highlights the need to better understand the specific channels via which high school vocational education affects labor market outcomes.

Our study sheds light on this debate by analyzing the impact of vocational education for workers in a broadly-defined occupation. By examining the effects of vocational education within an occupation we avoid confounding occupation and

vocational training effects. In addition, we look at a broader range of employment-related outcomes than in prior studies, including job attachment, job performance, and career progression. Economists generally have concentrated on wage or employment effects of vocational education. Industrial psychologists, who have studied effects on productivity, find that not only do occupational skills have a direct impact on worker productivity, but that their effect tends to exceed that of academic skills (Bishop 1989; Kang and Bishop, 1989).

By assessing the effect of vocational education on career progression and performance within an occupation, our goal is to identify the links between job knowledge and productivity. For example, vocational education in high school may result in more stable or longer careers within an occupation because it improves information on specific jobs and professions (sorting effect). Alternatively, vocational education may enhance job skills in a particular profession or broad occupational group, thus increasing worker productivity and resulting in more successful careers (human capital effect). Our study also investigates reasons why the wage effects of vocational education may be more pronounced for those who work in a training-related occupation.

The analysis exploits a specific high school program in military science, Junior Reserve Officers' Training Corps (JROTC), which is similar to other vocational-type programs. We exploit the unique link between JROTC and the military as the primary employer to identify individuals who pursue a career that matches their military vocational training in high school. Using a rich dataset of all new Navy recruits between 1994 and 2002 we compare the turnover and job performance of new 'hires' who did and did not complete high school JROTC. Military data are particularly well suited for this

investigation, since the military represents at the same time a single employer and a single broad occupational category.[1] These data also contribute to the vocational education literature by providing evidence on career progression of vocational trainees within an internal labor market (see Rosen, 1992; Asch and Warner, 2001). The military's highly structured hierarchical personnel system allows us to hold constant several important factors that can confound the estimated effects of vocational education. For example, one possibility not considered by prior studies is that new hires with vocational education may earn higher wages because they receive more firm-specific training than other new hires without vocational education. Since vocational graduates enter with a basic knowledge of the occupation, industry, or the specific employer, the firm would be more likely to offer them more advanced training or place them on fast tracks that result in steeper wage profiles. In the military, however, basic training is standardized for all new hires.

Publicly available data sources typically used to investigate vocational education do not allow for a within-occupation analysis of career progression. This is due partly to small samples for each identifiable occupation and due partly to lack of information on the careers within each occupation (which requires longitudinal internal firm data).[2] Furthermore, most vocational programs do not lead to one specific occupation. Indeed, the literature often lumps together several occupations that share similar characteristics when defining occupation-related training.[3] Matching vocational courses with occupation

[1] The military represents an 'occupational cluster' rather than a single homogeneous occupation (see Levesque et al., 2008). Moreover, as we discuss below the occupational clusters tend to differ across military branches.

[2] Hill (1989) analyzes effects of technical education on promotion, turnover, and time-to-train in several occupations for several employers, but concentrates on post-secondary training.

[3] In analyzing the vocational-education occupation match, Neuman and Ziderman (1999), for example, identify eight major occupational categories for vocational education, whereas Hotchkiss (1993) identifies

can be crucial to determining whether occupational choice or vocational education explains higher wages. Studies that do not control for occupational self-selection leave open the possibility that vocational education improves labor market outcomes by improving the self-selection of individuals into occupations rather than by improving occupational skills. By holding constant the occupation (and, thus, the self-selection of individuals into the occupation), our study permits a closer examination of the ways in which vocational education affects career outcomes. Studies that deal with such self-selection do not identify the channels through which vocational education increases earnings – through information about the occupation, or by increasing human capital in a particular field. For policy purposes the distinction is important as it helps shape and improves the delivery of vocational education.

II. Background

The JROTC program currently enrolls over 500,000 students in more than 3,300 high schools (nearly 20% of all public high schools).[4] Even though the program shares elements of both a vocational education and a school-to-work (STW) program,[5] it largely has been overlooked by social science researchers. This oversight may arise from the perception that military science classes represent 'special interest' activities rather than

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only two broad categories. It should be noted that, in general, the vocational education literature defines "occupation" in a broad sense. This could be due in part to the way that vocational courses are classified as linking to various occupations. For example, one of the nine vocational areas identified by the Department of Education is "agriculture and renewable resources," which includes farmers and other farm occupations, forestry, fishing, veterinary assistants, and gardening workers (Levesque et al., 2000).

[4] Program data is taken from Coumbe, Kotakis, and Gammell (2008), Crawford, Thomas, and Estrada (2004), and Laurence and Estrada (2003).

[5] STW programs include school-based learning, work-based learning, and connecting activities. School-based learning includes academic and vocational courses, whereas work-based learning includes hands-on job training, mentoring, and instruction in a workplace (through internships and apprenticeships, for example). STW connection activities establish partnerships with industries to ease the school-to-work transition. Similarly, JROTC activities are comparable to STW initiatives such as job shadowing, mentoring, and internships, which are intended to increase job market skills of young people, and guide them toward future careers.

programs intended to affect employment outcomes. The U.S. Department of Education (DOE) classifies high school military science classes as 'enrichment/other' rather than vocational education (Levesque et al., 2000). This designation appears to contradict DOE's own definition of career technical education (CTE) as classes that teach "….skills required in specific occupations or occupational clusters" (Levesque, et al., 2008, p. 3).[6] This classification also misrepresents the scope and content of JROTC.[7] As we discuss below, the curriculum design, the use of military instructors, and the close link with the employer all serve to reinforce the program's clear occupational orientation. JROTC 'concentrators' (those with at least 3.0 Carnegie credits in military science) earn an advanced pay grade if they choose to enlist, and about 40% of JROTC concentrators do enter the military (Center for Strategic and International Studies, 1999).[8] This is very close to the estimated percentage of vocational students who find employment in an occupation related to their training (Bishop, 1989). As a result, JROTC-trainees appear to be very similar to vocational trainees in other (civilian) areas.

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[6] The U.S. Department of Education (1987) labels military employment as a 'non-labor market activity,' which contradicts how labor economists analyze military manpower supply issues. In an all-volunteer military, employment in the military is a voluntary occupational choice made by youth (predominantly recent high school graduates) who weigh the monetary and non-pecuniary attributes of available jobs. These attributes include relative pay, any bonuses offered, training opportunities, and the arduousness and risk of the occupation. Like other employers, the military sets minimum standards for entry, based in part on AFQT scores and high school graduation (see Asch and Hosek, 2007; Warner and Asch, 2001), and must offer compensation packages sufficient to attract and retain the required quantity and quality of personnel (Hosek and Sharp, 2001).

[7] There is a second inconsistency in how DOE defines vocational classes. For secondary schools DOE defines an occupational category called 'protective services,' which does not include military science classes, whereas for college courses the same 'protective services' vocational category does include college-level military science classes (Levesque et al., 2008).

[8] It is noteworthy that the earnings of enlistees during a 4-year enlistment exceed the median earnings of comparable non-college-bound high school graduates. JROTC concentrators enter the military at pay grades E2 or E3, while other recruits generally enter at E1. In 2008 an enlistee in pay grade E3 with two years of service earned $36,352 in base pay and non-taxable allowances, the equivalent of $40,422 in taxable earnings (retrieved January 11, 2009 from www.defenselink.mil/militarypay/mpcales/calculator/RMC.aspx). In contrast, median civilian earnings for a 20 to 24-year-old male (all industries, all occupations) were $25,012 (retrieved January 11, 2009 from www.bls.gov).

Like vocational education and STW programs, JROTC offers both academic and vocational courses and is linked with a specific employer. The curriculum includes core subjects such as citizenship, communications, geography, health and wellness, and physical fitness. Each unit is affiliated with one of the four military branches and each uses retired military personnel as instructors.[9] In addition to general military courses, such as military history, national security issues, and leadership, each JROTC program includes courses in subjects related to their specific branch. For example, the Army JROTC curriculum includes geography, earth sciences, and orienteering, whereas the Air Force curriculum includes aerospace and aerodynamics. Core classes in the Navy curriculum are military structure and operations, military law, naval science (including sea navigation, rules of the road, and shipboard life), oceanography, meteorology, and Navy tactics and strategy (Laurence and Estrada, 2004; Coumbe, Kotakis, and Gammell, 2008).[10]

Prior research on JROTC is limited. Elliott et al. (2002) analyze a federal pilot program in 1992 that combined career academies with required JROTC participation.[11] They find that JROTC Partnership Academy students had better academic achievement than both students in a general track and 'regular' JROTC students. Pema and Mehay (2009a; b) investigate several academic and post-school outcomes for regular JROTC students. They find that JROTC students are two to four times as likely to enlist as their

[9] Local school districts hire the instructors who are compensated jointly by the school district and the Defense Department.

[10] The JROTC curriculum covers 180 hours per year, which translates to 1.0 credit. Generally, 130 hours are devoted to the core subjects, while 50 hours can be taken in optional or elective courses. The learning approach stresses group discussion, learning by doing, and teaching others as opposed to lecture. JROTC programs are accredited by the Commission on International and Trans-Regional Accreditation (CITA), which is used because some JROTC units are located abroad.

[11] The 'Federal-Local Partnership for Serving At-Risk Youth Program' was sponsored by both the Department of Education and Defense and attempted to combine the strengths of JROTC with the career academy focus on work-based learning (Hansen and Robyn, 2000).

peers. The authors find no employment effects for JROTC students who do not enlist, suggesting that program effects may be confined to those choosing an occupation related to the military training.

III. Data

We analyze pooled data on all recruit cohorts who entered the Navy between 1994 and 2001 and signed 4-year contracts. Each cohort member is tracked until separation or 5 years after entry. The Defense Manpower Data Center (DMDC) provided the personnel data, which contained 367, 241 observations. We focus solely on recruits with 4-year contracts to keep the length of initial skill training and follow-on career paths homogeneous. We also remove those with prior military service because they may have different tastes for the military than the typical new recruit and will have different career paths. Applying these restrictions left 329,180 observations. All JROTC recruits in our data set earned at least 3.0 JROTC credits in high school, which is the equivalent of an 'occupational concentrator,' as defined by DOE (Levesque et al., 2000; 2003).

To investigate the effects of occupational-related vocational education on job match, we analyze the link between completing high school JROTC and: (a) turnover during a recruit's 4-year contract term; and (b) voluntary reenlistment decisions at the expiration of the 4-year contract. Early military turnover (called 'attrition') reflects job mismatch and all such mismatches result in an individual being discharged, whether the source of the mismatch is the individual or the military.[12] We analyze reenlistment decisions at the expiration of the first contract to determine the effect of JROTC on job stability. Unlike attrition behavior, manpower analysts generally treat reenlistment

[12] Klein et al. (1991) show that official discharge reasons seldom identify the true reason for the mis-match and Buddin (1984) points out that it is difficult to distinguish military 'quits' from 'fires.'

behavior as a voluntary occupational choice based on expected future civilian and military earnings (Daula and Moffitt, 1995). Those who are well matched to the military will promote at a faster pace, which increases military earnings and provides incentives to stay. Turnover and reenlistment are indicators of job match and stability, which, for youth labor markets appear to be problematic (Yates, 2005). Neumark (2002) shows that unstable early job market experiences may have lasting adverse effects on adult labor market outcomes.

In contrast to prior studies that examine wages as indirect productivity indicators, we utilize an objective measure of productivity. Our measure of performance is based on being promoted during the 4-year contract. Position in the hierarchy accurately reflects military productivity since promotions (beyond E3) are highly competitive and are based on demonstrated performance, supervisors' evaluations, and skill qualification exams (Williamson, 1999).[13] Hence, we analyze the effect of JROTC on the grade level attained at the end of the contract. We also condition this effect upon entry grade to investigate whether wage differences are due to faster career progression within the firm, or due to the head start provided to JROTC graduates, who enter at advanced pay grades.

Columns 1 and 2 of Table 1 provide descriptive statistics for 'new hires' with and without JROTC. One notable difference is that recruits with JROTC backgrounds are more likely to be female or black, and to have lower AFQT scores than other recruits. They also have lower attrition rates and higher reenlistment rates. The next section investigates whether observed performance differences are systematic and whether they

[13] The personnel system consists of nine grades. The first three grades, (E1-E3) represent trainee and apprentice positions, the middle three grades (E4-E6) represent technician and work group manager/leader positions, and the three highest grades (E7-E9) represent supervisory positions (Williamson, 1999). During the initial 4-year contract, promotion to grade 4 (E4, petty officer third class) represents the target career progression for new entrants.

can be attributed to the vocational training received in high school.

IV. Estimating the Effect of JROTC on Careers

We first propose the following model for estimating the effects of vocational education on attrition, reenlistment, and promotion:

$$y_i = 1\left(\delta JROTC_i + \beta_1 \mathbf{X}_i + \beta_2 \mathbf{A}_i + \beta_3 \mathbf{M}_i + u_i > 0\right), \quad i = 1,...,N \tag{1}$$

where y_{it} denotes the selected outcomes, $\mathbf{X}_i$ includes demographics (race/ethnicity, gender, marital status, dependents, and an interaction of the last two variables). $\mathbf{M}_i$ represents institutional-specific variables, including eight cohort dummies and dummies for 10 military occupational areas. After receiving initial (basic) training, recruits receive advanced training in a specific occupational field. Controlling for these occupational areas helps isolate the effect of high school vocational education from internal training. Cohort dummies proxy for civilian labor market conditions, as well other unmeasured differences across cohorts (due, for example, to fluctuations in recruiting policies). $\mathbf{A}_i$ includes AFQT scores and educational attainment prior to enlistment.

We estimate (1) via probit under the assumption that u_i does not include unobservables correlated with program participation and outcomes. However, because JROTC participation and the choice of a military career may be jointly determined, the error term in a JROTC participation equation may be correlated with employment attachment. This correlation would be positive if individuals who participate in JROTC have a stronger taste for the military. Pema and Mehay (2009a, b) show that high school students who participate in JROTC have stronger preferences for military careers than their peers. In contrast to their studies, our sample includes only military recruits so taste-selection is less problematic. However, if those with JROTC backgrounds have relatively

stronger tastes for the military, it is possible our job-attachment estimates would be positively biased.

The correlation between JROTC participation and military careers could also be negative if JROTC attracts at-risk or disadvantaged students, who tend to have poorer employment prospects after high school. Pema and Mehay (2009a; b) find that JROTC students have more at-risk characteristics than other high school students: they are more likely to live in single-parent and lower-income households, and to attend urban high schools with high enrollments of disadvantaged students. If JROTC recruits are negatively selected, then our baseline estimates of career success may be negatively biased. Since, a priori, it is unclear which effect dominates; we pursue alternative estimation methods to address the self-selection problem.

First, we model participation in the program and enlistment as simultaneous decisions. Matching information from the recruits' addresses before enlisting and schools in the area that offered JROTC, we instrument program participation with an indicator for whether any high schools in the zip code offered JROTC.[14] For recruit *i* living in area *j* we specify the following model:

$$y_{ij} = 1\left\{\delta JROTC_{ij} + \gamma_1 \mathbf{X}_i + \gamma_2 \mathbf{A}_i + \gamma_3 \mathbf{M}_i + \gamma_4 \mathbf{L}_j + u_{ij} > 0\right\}, \quad i = 1,..., N \tag{2}$$

$$JROTC_{ij} = 1(\pi_1 \mathbf{X}_i + \pi_2 \mathbf{A}_j + \pi_3 ZIPJROTC_j + \pi_4 \mathbf{L}_j + v_{ij} > 0) \tag{3}$$

$$\begin{bmatrix} u_{ij} \\ v_{ij} \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix}\right) \tag{4}$$

The variable $ZIPJROTC_i$ is a dummy indicating the presence of a JROTC program

[14] Zip codes for each recruit were provided in the DMDC personnel files. The zip codes for each JROTC high school were obtained directly from the military's cadet commands.

in a high school in the recruit's zip code. Equation (3) assumes that program participation is a function of individual characteristics and ability ($\mathbf{X}_i$, $\mathbf{A}_i$), whether there are any schools that offer JROTC in the zip code ($ZIPJROTC_j$), and local area characteristics ($\mathbf{L}_j$, discussed below). Identification requires that the excluded variable, $ZIPJROTC_j$, predicts individual participation in JROTC among recruits, but is uncorrelated with unobserved factors associated with military career outcomes y_{ij}.

The first assumption appears reasonable since Pema and Mehay (2009b) show that over 80% of high school students who participate in JROTC do so if their school offers the program.[15] In regressions described below, $ZIPJROTC_j$ always has statistically significant coefficients. The second condition for a valid instrument is that $E\left[y_{ij} \mid JROTC_{ij}, \mathbf{X}_i, \mathbf{A}_i, \mathbf{M}_i, \mathbf{L}_j\right]$ should not depend on whether schools in the recruit's home area offered JROTC. Ideally, if schools randomly offered the program, $ZIPJROTC_j$ would not affect career outcomes other than through individual participation. Therefore, in the absence of school-level selection into JROTC, this model would adequately address individual self-selection. However, Pema and Mehay (2009b) find that JROTC programs tend to be placed in poor urban areas with high recruitment potential. Consequently, the program's presence will be correlated with other unobserved characteristics of the recruit and the area. Both of these may affect career outcomes.

To deal with this problem, in equation (1) we explicitly control for economic and social characteristics of the local area ($\mathbf{L}_j$) where the recruit lived before enlisting. These variables include county-level unemployment rates and per capita earnings for each year from 1990-2007. These variables and the time period chosen represent local economic

[15] Some students take JROTC courses in other local schools when their own school does not offer JROTC.

conditions from the time that the recruits are in high school through their first term of service when they are making reenlistment decisions. From the 1990 and 2000 Censuses we also obtain county-level data on the number of people serving in the armed forces, population in poverty, and percent of the population that is black, Hispanic, or American Indian. Since placement of JROTC units tends to focus on poorer areas and those with high recruiting potential, we expect that the total military and poverty population (rather than percent of population in each category) will better control for local characteristics correlated with the presence of a JROTC unit. The inclusion of per capita income, unemployment, military presence, minorities, and poverty status allows the effect of our IV to emerge only via individual participation in JROTC. These variables proxy for economic and social conditions in the area that affect the school's ability to qualify for JROTC and that may also be correlated with job attachment and choice of the military as a future career.

If there are other local area characteristics that are unobservable and that are correlated both with student participation in JROTC and individuals' career outcomes, our bivariate probit results would be biased. For example, if areas that offer JROTC in their high schools offer fewer career opportunities due to the type of industries and employers located in the area, we may observe that JROTC recruits are more likely to stay in the military. Although explicitly controlling for local unemployment, earnings, and poverty addresses this issue, the concern remains that there are other unobservable local conditions that affect both participation and career progression. In addition, the previous analysis controls for economic and social factors at the county level, which may be appropriate measures of labor market conditions, but may not fully capture the social

characteristics of the local area where the recruit attended high school (especially in highly-segregated areas).

To address these concerns, we also obtain program effects from comparing JROTC recruits with non-JROTC recruits from the same zip code. To do so, we estimate fixed effects models that net out both observable and unobservable characteristics at the zip code level that may be correlated with both career progression and the presence of JROTC in their schools. If we enhance the original model to include the unobserved characteristics of the local area l_j we obtain:

$$y_{ij} = 1\left(\phi JROTC_i + \theta_1 \mathbf{X}_i + \theta_2 \mathbf{A}_i + \theta_3 \mathbf{M}_i + \theta_4 \mathbf{L}_j + l_j + e_{ij} > 0\right), \quad i = 1,...,N, \;\; j = 1,...,J \qquad (4)$$

If we assume that e_{ij} follows a logistic distribution conditional on both observable and unobservable variables, then

$$P\left(y_{ij} = 1 \mid \mathbf{X}_i, \mathbf{A}_i, \mathbf{M}_i, \mathbf{L}_j, JROTC_i, l_j\right) = \Lambda\left(\phi JROTC_i + \theta_1 \mathbf{X}_i + \theta_2 \mathbf{A}_i + \theta_3 \mathbf{M}_i + \theta_4 \mathbf{L}_j + l_j\right) \qquad (5)$$

can be estimated via conditional maximum likelihood. This approach provides estimates that are conditional upon both observable and unobservable area-specific effects $\mathbf{L}_j$ and l_j.

For identification this method requires that both JROTC participation and the outcomes vary within a zip code. For example, fixed effects logit does not draw any information from local areas where none of the sampled recruits attrite from the Navy, or where all recruits reenlist. This also addresses the bias due to l_j, since local unobservables could produce a never-attrite or always-reenlist outcome. This method effectively reduces the sample to areas with JROTC schools, and eliminates all recruits in areas without JROTC schools. Because most areas contain only one JROTC unit (operated by one of the four military branches), fixed effects estimates will not depend on branch-specific

program variation. Compared to baseline and bivariate probit estimates, the fixed effects estimates are not contaminated by bias from the possible correlation of $JROTC_i$ with l_j.

V. Baseline Estimates

Probit estimates of attrition and reenlistment are presented in panel A of Table 2. Prior research shows that females have more difficulty adapting to military life and tend to attrite at higher rates (Buddin 2005), thus we also estimate program effects separately by gender. It could be that females gain more from experiencing military life via JROTC without incurring a service obligation. Apprehensions about a military career could explain why more female recruits than males enter the military with JROTC backgrounds.

We examine both short-term and long-term job attachment by analyzing attrition rates over various intervals – 12, 24, 36, and 48 months. The results indicate that JROTC participants have attrition rates between 3.1-3.5 percentage points lower than non-participants (or 9-17%). If JROTC helps students make better-informed career decisions, we would expect program participants to have better and more stable job matches. The JROTC effect on turnover appears to be similar across males and females.

Reenlistment estimates are presented in panel B of Table 2. We estimate reenlistment models for the sample of sailors who complete their contracts (stay at least 36 months) and who are eligible to reenlist. According to these estimates, JROTC participation increases retention by 5.5 points (9%).[16] If we assume that individuals who do not attrite early from the military have a stronger taste for the military or represent a better job match, then the JROTC effect obtained on the sample restricted to those who

[16] Full results are available upon request.

stay at least 36 months should provide a stronger test of the program effect on job stability. Conditional on surviving 36 months, we find that JROTC recruits are about 8% more likely to reenlist.

V. Bivariate Probit Estimates

To control for the potentially simultaneous decision between joining JROTC and pursuing a military career, we next obtain bivariate probit estimates of the program effects on attrition and reenlistment. As an instrument for JROTC we use an indicator for whether any schools in the recruit's zip code offered JROTC. About 41,176 recruits in our sample (16%) lived near a school that offered JROTC.[17]

Attrition and reenlistment results are presented in Table 3. After instrumenting for the potentially endogenous program participation, we find that the program has an even stronger effect on these two outcomes. In particular, the attrition effect ranges from 12-17 percentage points, three times larger than the effect obtained in the baseline probits. Interestingly, females display a more pronounced program effect on attrition than do males. The larger estimates of the program effect are consistent with the hypothesis that JROTC participants are negatively selected and have unobserved characteristics that make them more likely to attrite and less likely to reenlist. The estimated correlation between the error terms in the participation and outcome equations also supports this claim: $\hat{\rho}$ is positive and significant in the attrition models, but negative in the reenlistment models. Therefore, our previous baseline estimates appear to underestimate the effect of

[17] It should be noted that in what follows we exclude individuals with erroneous zip code information (about 20% of the observations). However, since we are using population data for eight cohorts of recruits, this data restriction does not substantially affect sample size or generalization of results. We found no evidence that erroneous zip codes were correlated with any observable characteristics of the recruits. Summary statistics for this restricted sample appeared very similar to the full sample. We believe that erroneous zip codes are due to coding errors.

the program on both job match and stability.

VI. Fixed Effects Estimates

Next, we obtain estimates for the typical JROTC recruit by focusing on recruits who lived in the same zip code before enlisting, and by comparing those with and without JROTC. This estimation strategy differs from bivariate probit by not depending on an outside source of variation to predict participation. Fixed effects estimation assumes that recruits from the same zip code who did not participate in JROTC are more appropriate controls for JROTC participants than the average non-participant in the sample. This could be especially true if we assume that recruits who live in the same locality make participation, enlistment, and reenlistment decisions influenced by the same economic and social conditions.

Fixed effects logit estimates of the treatment effects are tabulated in Table 4 (odds-ratios appear in brackets). JROTC participants are 17-23% less likely to attrite at different points in the first term, with the smaller effects occurring later in the term. Although fixed effects estimates are notably smaller than the bivariate probit estimates they still exceed the baseline estimates (which ranged from 9 to 17%)**,** consistent with negative selection of JROTC participants. With respect to long-term job stability, JROTC participants are 22% more likely to reenlist than non-participants who resided in the same zip code. The magnitude of this effect exceeds both the baseline and the bivariate probit estimates.

The effect of JROTC on attrition is substantially larger for women than for men in both the bivariate probit and fixed effects results. The positive effect of JROTC on reenlistment decisions is confined to males in the bivariate probit results, but extends to

both males and females in the fixed effects results.

Compared to the baseline estimates, fixed effects deal with the bias induced from unobserved economic and social characteristics of the local area where JROTC recruits live, which may affect their decisions to join JROTC and to pursue a military career. Compared to the bivariate probit model, fixed effects methods recover the treatment effect for the typical JROTC recruit, or the treatment effect on the treated (ATT), whereas the former identifies the local treatment effect (LATE) from recruits who join JROTC because local schools offer the program. The difference in the estimates suggests that students induced to participate because the program is offered by the school gain more in terms of job match than the typical student who participates in JROTC. Fixed effects attrition estimates may be smaller than bivariate probit estimates also because the former do not control for the potentially higher military taste of JROTC participants, which may introduce a positive bias in the results. However, instrumenting individual participation with school offerings accounts for the possibility that recruits with JROTC backgrounds have a higher relative taste for the military, since the placement of the JROTC units in schools is not affected by the preferences of any single individual. For the purpose of evaluating the overall effect of the program, both the ATT and the LATE estimates are important. The average participant appears to have a more stable career and better job match than the average non-participant; however, these effects may be even stronger for marginal participants who would not have joined this program, had it not been for its availability.

VII. Career progression

To investigate the productivity effect of JROTC, we separately analyze promotion

to pay grades E4 and E5, which are the first competitive promotions during the first contract. Promotion to E4 is the targeted progression for new recruits based on 'normal' performance in training schools and on the job. In contrast, promotion to E5 reflects superior performance. The analysis of promotions is complicated by the fact that JROTC participants normally enter the military at advanced pay grades (on average at E3, versus E1 for most non-JROTC recruits). To account for this, we also estimate promotion models that control for entry pay grade.[18]

Promotion results are presented in Table 5. All promotion models include individuals who survive for all four years. In Panel A, the baseline probit results indicate that JROTC recruits are slightly less likely to promote to the E4 grade. Controlling for their advanced entry pay grade increases this negative gap slightly (to 3.3 percentage points, or 3.6%). JROTC recruits are also less likely to promote to E5.

In Panel B, the bivariate probit results reveal no significant differences in career progression for JROTC versus non-JROTC recruits. However, for females, the results suggest a positive effect of JROTC on promotion, even when conditioning upon entry grade. In Panel C, fixed effects estimates suggest that JROTC concentrators advance no differently than non-participants, but, when controlling for their advanced placement at entry, graduates progress more slowly.

VIII. Occupation-specific Vocational Training

To this point we have analyzed the effect of participation in 'any' JROTC program on job performance. However, some Navy recruits with JROTC backgrounds complete a Navy-JROTC program whereas others complete a non-Navy program. The

[18] In addition, promotion timing is complicated by assignment of individuals to advanced skill training, which are based on ASVAB test scores, and the required training time for each skill area (Krause and Wenger, 2004).

military's lifestyle and culture and its rigid internal labor market are sufficiently unique that the general job information, skills, and principles provided by all JROTC programs convey considerable value to program graduates. However, Navy-JROTC graduates receive more specific job information and training. Hence, 'any JROTC' will incorporate a continuum of skills ranging from general military knowledge to very job-specific skills. To differentiate the impact of these two backgrounds, we next separate those with JROTC backgrounds into those who completed Navy JROTC (NJROTC) and those who completed non-Navy JROTC (OJROTC). Comparing these two groups provides insights into whether occupation-specific training has a stronger effect than more general military training.[19] Assuming that all JROTC participants share a similar military propensity, a comparison of NJROTC with OJROTC recruits provides a stronger test of the effect of occupation-specific vocational training on job attachment. Estimates are presented in Table 6. Also, since all entrants with JROTC receive an advanced pay grade, this analysis sorts out whether occupation-specific skills are driving any differences in performance, especially promotion.

For all of the attrition indicators in panel a, males with NJROTC are less likely to attrite than both recruits with no JROTC background and those who complete a non-Navy JROTC curriculum. In contrast, for females it appears that completing a non-Navy JROTC curriculum is responsible for their lower early turnover. This suggests that women may benefit more from general military skills and job information than from Navy-specific vocational training.[20]

[19] Bishop (1989) provides evidence that occupation-specific skills leads to better job performance than general vocational training.

[20] In auxiliary regressions in which the samples are restricted to JROTC participants, the difference in attrition rates between NJROTC and OJROTC recruits was significant in all regressions.

Panel B presents reenlistment results for Navy-specific JROTC trainees. The effect of completing Navy-JROTC on reenlistment appears quite strong for males, and dominates the effect of completing a non-Navy JROTC program. In contrast, for females, non-Navy JROTC again appears to have the stronger relative effect on reenlistment outcomes.

Because we have no separate instruments for participation in Navy-specific JROTC and non-Navy JROTC, we do not estimate the differential effect of the curriculum for these subgroups via bivariate probit. However, the fixed effects estimates confirm the baseline estimates, suggesting that Navy-specific occupational training is associated with higher gains than general military training.

IX. Conclusions

This study contributes to the debate on the benefits of high school vocational education and STW programs. While the literature focuses on wages as an indicator of labor market success, we investigate the effect of programs that aim to smooth the transition from school to work on individual career progression. We use a rich data set on eight cohorts of new Navy recruits who received military-specific training in high school via the Junior ROTC program.

We find that the occupation (military) training in high school received via the JROTC program reduces the short-term turnover of new recruits, improves their measured job productivity, and increases long-term job stability. These effects appear to be driven in part by the occupation-specific skills received in high school, since males who completed Navy-JROTC perform better in the Navy than males who completed non-Navy JROTC programs. Interestingly, for females, attending any JROTC curricula

proves beneficial in terms of job performance. Females appear to benefit more from general military training and information, rather than from Navy-specific training. The results suggest that an important effect of vocational training is to improve job match quality. While wage effects of vocational education may be disputable, depending on whether they are measured in the short or the long run, our results suggest that vocational education may increase life-time earnings by improving job match and job stability.

Our results support prior studies that find that vocational education students do better when they work in jobs directly related to their occupational training (Neumann and Ziderman, 1991; 1993). The reason appears to be that enhanced occupational skills improve the job match and reduce both short term and long term turnover. It is noteworthy that the military requires extensive firm-specific training of new recruits, thus one benefit of the lower turnover is to increase the organization's incentives to invest in further firm-specific training. Our results also support arguments that employer involvement in vocational education is important to students' ultimate success (Bishop 1989). It is perhaps surprising that we find no promotion advantage for JROTC students. This result is most likely due to the job hierarchy in the military and the promotion rules that base promotion, in part, on time-in-grade and time-in-service.

Table 1. Descriptive Statistics

Variable	JROTC Recruits	Non-JROTC Recruits
Female	0.218	0.172
	(0.413)	(0.378)
African-American	0.354	0.184
	(0.478)	(0.388)
Hispanic	0.078	0.108
	(0.269)	(0.310)
AFQT percentile	57.582	60.768
	(18.318)	(18.794)
No High School Diploma	0.028	0.037
	(0.164)	(0.189)
Certificate or GED	0.045	0.072
	(0.208)	(0.259)
High School Diploma	0.902	0.842
	(0.297)	(0.365)
Some College	0.018	0.031
	(0.132)	(0.173)
College Degree	0.007	0.018
	(0.084)	(0.132)
Attrite in 12 months	0.172	0.210
	(0.377)	(0.407)
Attrite in 24 months	0.247	0.285
	(0.431)	(0.452)
Attrite in 36 months	0.312	0.342
	(0.463)	(0.474)
Attrite in the first term	0.353	0.387
	(0.478)	(0.487)
Reenlist	0.443	0.390
	(0.497)	(0.488)
Promote to E4	0.828	0.886
	(0.377)	(0.318)
Promote to E5	0.198	0.268
	(0.398)	(0.443)
Observations	9,347	316,213

The sample includes Navy recruits who enlist during 1994-2001 with 4-year contracts. It excludes prior enlisted recruits.

Table 2. The Effect of JROTC on Job Match and Job Stability

	All	n	Males	n	Females	n
Panel A. Job match						
12-month attrition	-0.132	325,560	-0.134	269,020	-0.106	56,540
	(0.016)***		(0.018)***		(0.034)***	
	[-0.035]		[-0.036]		[-0.030]	
24-month attrition	-0.116	325,560	-0.112	269,020	-0.101	56,540
	(0.015)***		(0.016)***		(0.031)***	
	[-0.038]		[-0.036]		[-0.033]	
36-month attrition	-0.088	325,560	-0.081	269,020	-0.081	56,533
	(0.014)***		(0.016)***		(0.030)***	
	[-0.031]		[-0.029]		[-0.030]	
first term attrition	-0.094	325,560	-0.091	269,020	-0.075	56,533
	(0.014)***		(0.015)***		(0.030)**	
	[-0.035]		[-0.034]		[-0.029]	
Panel B. Job stability	0.144		0.140		0.132	
reenlistment	(0.017)***	207,825	(0.019)***	172,484	(0.037)***	35,341
(36 month stayers)	[0.055]		[0.053]		[0.051]	

Notes: All regressions include demographics (age, gender, race, marital status, number of children), AFQT scores, education, and cohort dummies. With the exception of 12- and 24-month attrition, the models also include dummies for military sub-specialties (10 categories).
Standard errors are in parentheses and marginal effects are in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3. Bivariate Probit Estimates of JROTC Effects on Job Match and Job Stability

	All	n	ρ	Males	n	ρ	Females	n	ρ
Job match									
12-month attrition	-0.517	253,815	0.18	-0.473	209,548	0.16	-0.505	44,267	0.18
	(0.137)***		(0.06)***	(0.161)***		(0.07)**	(0.256)**		(0.12)
	[-0.117]			[-0.108]			[-0.119]		
24-month attrition	-0.464	253,815	0.15	-0.291	209,548	0.08	-0.631	44,267	0.24
	(0.128)***		(0.06)***	(0.154)*		(0.07)	(0.230)***		(0.11)**
	[-0.134]			[-0.089]			[-0.174]		
36-month attrition	-0.489	253,815	0.18	-0.381	209,548	0.13	-0.542	44,267	0.21
	(0.123)***		(0.06)***	(0.141)***		(0.06)**	(0.237)**		(0.11)*
	[-0.157]			[-0.126]			[-0.175]		
first term attrition	-0.507	253,815	0.18	-0.423	209,548	0.15	-0.465	44,267	0.17
	(0.121)***		(0.05)***	(0.142)***		(0.06)**	(0.239)*		(0.11)
	[-0.174]			[-0.148]			[-0.164]		
Job stability									
reenlistment	0.228	161,925	-0.04	0.203	134,182	-0.03	0.023	27,743	0.05
(sample: 36 month stayers)	(0.107)**		(0.05)	(0.123)*		(0.06)	(0.199)		(0.10)
	[0.086]			[0.076]			[0.009]		

Notes: All regressions include demographics (gender, race, marital status, number of children), AFQT scores, education, and cohort dummies. Reenlistment models also include dummies for military specialties (10 categories). Additionally, all regressions include the following county-level variables: unemployment rates and per-capita income (in log form) for each year from 1990-2007; the county population serving in the Armed Forces (in log form) based on the 1990 and 2000 Census; the population living below poverty level (in log form) from the 1990 and 2000 Censuses, and the percent of the population black, Hispanic, and American Indian from the 2000 Census. The instrument for JROTC is an indicator for whether any high schools in the recruit's zip code offered JROTC. The zip code was missing or erroneous for 20% of the original sample. These recruits were excluded from the sample used in these regressions.
Standard errors are in parentheses and are robust to within-county correlation. Marginal effects appear in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4. Fixed Effects Estimates of JROTC on Job Match and Job Stability

	All	N (zip codes)	Males	Females
Job match				
12-month attrition	-0.260	252,937	-0.260	-0.288
	(0.033)***	3,773	(0.037)***	(0.115)**
	[0.771]		[0.771]	[0.750]
24-month attrition	-0.230	253,660	-0.222	-0.234
	(0.029)***	3,860	(0.032)***	(0.084)***
	[0.795]		[0.801]	[0.792]
36-month attrition	-0.185	253,782	-0.173	-0.176
	(0.027)***	3,877	(0.030)***	(0.072)**
	[0.831]		[0.841]	[0.839]
first term attrition	-0.182	253,844	-0.172	-0.144
	(0.026)***	3,887	(0.029)***	(0.066)**
	[0.834]		[0.842]	[0.866]
Job stability				
reenlistment	0.205	161,708	0.194	0.214
(sample: 36 month stayers)	(0.032)***	3,791	(0.037)***	(0.072)***
	[1.228]		[1.215]	[1.239]

Notes: The average number of individuals in the same zip code is 60, with a minimum of 2 and a maximum of 846.
Standard errors are in parentheses; odds-ratios in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5. Alternative Estimates of Promotion Outcomes

	Panel A. Probit			**Panel B.** Bivariate probit			**Panel C.** Fixed Effects		
	All	Males	Females	All	Males	Females	All	Males	Females
Promotion to Rank E4	-0.096	-0.115	-0.032	0.242	0.038	0.901	-0.148	-0.159	-0.136
	(0.023)***	(0.027)***	(0.048)	(0.273)	(0.270)	(0.302)***	(0.052)***	(0.060)***	(0.114)
	[-0.014]	[-0.016]	[-0.006]	[0.029]	[0.005]	[0.107]			
Promotion to Rank E4	-0.209	-0.229	-0.142	0.046	-0.156	0.769	-0.333	-0.379	-0.326
(controlling for entry rank)	(0.024)***	(0.028)***	(0.050)***	(0.289)	(0.272)	(0.321)**	(0.055)***	(0.063)***	(0.119)***
	[-0.033]	[-0.034]	[-0.029]	[0.006]	[-0.022]	[0.097]			
Promotion to Rank E5	-0.035	-0.039	-0.039	0.113	-0.086	0.611	-0.068	-0.102	-0.042
	(0.022)	(0.025)	(0.054)	(0.244)	(0.256)	(0.365)*	(0.046)	(0.052)**	(0.124)
	[-0.009]	[-0.011]	[-0.007]	[0.032]	[-0.024]	[0.146]			
Promotion to Rank E5	-0.218	-0.219	-0.222	-0.462	-0.651	0.223	-0.355	-0.383	-0.372
(controlling for entry rank)	(0.023)***	(0.025)***	(0.056)***	(0.250)*	(0.234)***	(0.432)	(0.047)***	(0.053)***	(0.130)***
	[-0.054]	[-0.058]	[-0.034]	[-0.101]	[-0.14]	[0.043]			
N	111,773	92,669	19,104	87,144	72,111	15,033	85,477	70,387	11,446

Table 6. Estimates of the Effect of Navy-Specific JROTC on Job Match and Job Stability

		Probit			Fixed Effects
Panel A. Job match		All	Males	Females	All
12-month attrition:	Navy JROTC	-0.202	-0.228	-0.092	-0.348
		(0.029)***	(0.032)***	(0.060)	(0.059)***
		[-0.052]	[-0.058]	[-0.026]	[0.706]
	Other JROTC	-0.101	-0.093	-0.112	-0.222
		(0.019)***	(0.021)***	(0.040)***	(0.039)***
		[-0.027]	[-0.025]	[-0.031]	[0.801]
24-month attrition:	Navy JROTC	-0.181	-0.202	-0.085	-0.307
		(0.026)***	(0.029)***	(0.056)	(0.051)***
		[-0.058]	[-0.063]	[-0.028]	[0.736]
	Other JROTC	-0.087	-0.073	-0.108	-0.196
		(0.017)***	(0.020)***	(0.037)***	(0.034)***
		[-0.028]	[-0.024]	[-0.036]	[0.822]
36-month attrition:	Navy JROTC	-0.161	-0.167	-0.115	-0.264
		(0.025)***	(0.028)***	(0.055)**	(0.048)***
		[-0.057]	[-0.058]	[-0.042]	[0.768]
	Other JROTC	-0.055	-0.043	-0.067	-0.149
		(0.017)***	(0.019)**	(0.036)*	(0.032)***
		[-0.020]	[-0.015]	[-0.024]	[0.862]
first term attrition:	Navy JROTC	-0.150	-0.158	-0.096	-0.233
		(0.024)***	(0.027)***	(0.053)*	(0.046)***
		[-0.056]	[-0.059]	[-0.037]	[0.792]
	Other JROTC	-0.069	-0.060	-0.066	-0.158
		(0.016)***	(0.019)***	(0.035)*	(0.031)***
		[-0.026]	[-0.022]	[-0.025]	[0.854]
Panel B. Job stability					
reenlistment:	Navy JROTC	0.169	0.187	0.081	0.198
		(0.029)***	(0.032)***	(0.064)	(0.054)***
		[0.064]	[0.070]	[0.031]	[1.219]
	Other JROTC	0.131	0.115	0.156	0.209
		(0.021)***	(0.023)***	(0.044)***	(0.039)***
		[0.050]	[0.044]	[0.060]	[1.233]

See Notes to Table 2.
The difference in estimated effects between Navy and Other-JROTC is significant in all Column 1 models.

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